THURSDAY, DECEMBER 10, 1914.

RELATIVITY.

The Theory of Relativity. By Dr. L. Silberstein. Pp. viii + 295. (London: Macmillan and Co., Ltd., 1914.) Price 10*s.* net.

THE appearance of a connected account of the Principle of Relativity in our own language will be welcomed by many as an opportunity of acquainting themselves in more detail with the ins and outs of a controversial subject. The note of controversy is, however, almost completely absent from this book. There is scarcely a reference to the longings of the physicist for an objective æther, save the sentence, "Lorentz had not the heart to abandon the æther which he confessedly 'cannot but regard as endowed with a certain degree of substantiality.'" The readiness to "abandon" well-worn concepts and old-established theory is becoming a marked feature of the thought of physicists to-day. We are witnessing at this moment a revolutionary movement in the 'quantum theory' which at times seems to forget entirely the classical electrical theory, and all the wealth of experimental evidence out of which it grew. In the same way the exponents of the principle of relativity have found delight in pouring contempt on the æther as the basis of electromagnetic influence, while in their turn the more conservative of physicists, failing to see how natural was the transition from Lorentz' theory of optical and electromagnetic phenomena in moving bodies to the novel point of view of Einstein, seized upon the somewhat artificial system of clocks by which the latter sought to make his meaning clear, and found in it a laughing-stock.

It is strange that there has been so much difficulty in making the fundamental point of view of this theory clear to those whose interests are experimental rather than theoretical. Many will read Dr. Silberstein's careful and detailed introduction to it, consider his illustrations, and follow his logic, and yet feel there is something lacking. The 'argument from need' for an æther is not dealt with. The reluctance that Lorentz had to abandon the æther remains. The seeker after a deeper understanding of the physical is apt to fight shy of a principle which cannot be expressed in terms of concepts to which he can give some 'degree of substantiality.' A systematic exposition of the principle of relativity necessarily consists very largely in the demonstration of invariant properties of certain mathematical relations. Hence it is almost bound to appear a little uninteresting to the experimentalist. Dr. Silberstein compresses the purely mathematical discussion, and judiciously separates it from the general and descriptive account as far as possible. He shows how many of the invariant relations fall simply and naturally into quaternionic form. But little is done to remove the unfortunate impression that relativity is a fad of the mathematician, and not a thing for the every-day physicist. It is to be feared that many will turn to this book full of hope, and come away from it feeling that the subject is barren for the future. For the universe is not compact of quaternions or matrices. As a physical principle, the principle of relativity needs to be placed in its relation to other great generalisations, such as the conservation of energy and momentum, and the status of the fundamental concepts of space and time in mathematical physics needs to be clearly realised.

The present book gives an adequate supply of material for meeting these needs; the account of the developments which led up to Einstein's work is useful and clear; but the reader will need imagination and sympathy if he is to find here an answer to the many difficulties which the subject raises.

PRACTICAL CHEMISTRY.

(1) *The Elements of Qualitative Chemical Analysis.* By Prof. Julius Stieglitz. Vol. i.; Fundamental Principles and their Application. Pp. xi + 312. Vol. ii.: Laboratory Manual. Pp. viii + 153. (London: G. Bell and Sons, Ltd., 1914.) Price 6*s.* net each volume.

(2) *Introduction to Modern Inorganic Chemistry.* By Dr. J. W. Mellor. Pp. xvi + 684. (London: Longmans, Green and Co., 1914.) Price 4*s.* 6*d.*

(3) *Allen's Commercial Organic Analysis.* Vol. viii. Fourth edition. Entirely re-written. Edited by W. A. Davis and S. S. Sadtler. Pp. x + 696. (London: J. and A. Churchill, 1914.) Price 21*s.* net.

(4) *Handbuch der Arbeitsmethoden in der anorganischen Chemie.* Herausgegeben von Dr. Arthur Stahler. Dritter Band. Erste Hälfte. Pp. x + 692. (Leipzig: Veit and Co., 1913.) Price 22 marks.

(5) *Quantitative Analysis by Electrolysis.* By A. Classen. With the co-operation of H. Cloeren. Translated from the thoroughly revised fifth German edition by Prof. W. T. Hall. Pp. xiv + 308. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 10*s.* 6*d.* net.

(6) *Anleitung zur Darstellung Phytochemischer*

Uebungspräparate. By Dr. D. H. Wester. Pp. xi+129. (Berlin: Julius Springer, 1913.) Price 3.60 marks.

(1) QUALITATIVE analysis still forms the beginning of all instruction in chemistry, but in its modern form it no longer takes the guise of the familiar tables, supported by the test-tube rack and the shelf of reagents. Indeed, at the hands of the more advanced apostles of physical chemistry it has been altered beyond all recognition, and it is from this point of view that we must criticise the new contribution of Prof. Stieglitz to the literature. The method of instruction advocated by him aims at developing the critical searching mind of the professional productive chemist. The students taking his course are supposed to have been prepared in general chemistry on physico-chemical lines.

In part i. of the new work the student is started off on fundamental principles, and he is involved at once in the consideration of osmotic pressure, theories of solution, ionisation, chemical and physical equilibria, as a preliminary to undertaking the systematic analysis described in part ii. For those few students who can stand it the treatment is admirable, but it demands teaching of the very highest class to make it at all successful, as well as very great concentration on the part of the student.

The second volume is entirely a laboratory manual devoted to the study of reactions and systematic analysis. The text, which is interleaved with blank pages, consists of a series of instructions of the usual type with the variation that the "ionic phraseology" is used throughout.

From the point of view of those who follow the new school the book is one of the best of its kind —whether it will help to produce another Hoffmann or Faraday, or what is as important, a Mond or a Muspratt, is more open to question.

(2) Dr. Mellor's "Modern Inorganic Chemistry" has already won a place on the shelves of most chemists, so that his new introduction, written from a more elementary point of view, should need no external recommendation. The author's statements as to what a student may expect from a general course of chemistry are worth quoting even at a risk of repetition, as too many of the modern text-books have already the opposite tendency. They are:—(1) Skill in observation and experiment; (2) memory and knowledge of relevant facts; (3) ability to reason and think in a logical, systematic way; (4) cultivation of the imagination; (5) development of a critical and impartial judgment.

The finished student with these attributes would not seek long for a lucrative position.

(3) The volume under notice completes the new edition of this well-known work, though we understand that a supplemental volume bringing the whole work up to date is in course of preparation. The articles on the analytical examination of the proteins are written by eleven authors whose names are sufficient guarantee of the completeness of the sections. It would be easy to quote small details where errors or omissions had been made, but it is fairer to comment on the vast mass of information which the volume contains and to praise the industry which has gone to its making, the more especially as such work is well known to be largely a labour of love. The new edition of Allen's work will more than maintain the reputation won by its forerunners.

(4) Dr. Stahler's work is an example of the modern omnibus type of German dictionary, full of every possible detail, and no doubt of the utmost value. The facts that it is very costly, so large as to make search in it a matter of difficulty, that it is published spasmodically in any sort of order, and contains a great amount of padding, all militate against it being found outside a few large university libraries. Furthermore, like so many recent German works, it tends to ignore much of the work done outside Germany, and so sacrifices any claim to completeness.

(5) It will be generally admitted that not the least of the advantages derived from the modern advances in electro-chemistry are the many valuable methods of analysis which have been based on them. In particular many of the methods are in use in those cases where speed is essential.

Prof. Classen's German text, which was published originally as long ago as 1882, is very widely known, and has passed through several editions. Prof. Hall has done a considerable service in bringing the English edition again up to date. The table of contents illustrates sufficiently how widely electro-analytical methods are applicable both to the more simple operations, such as the separation of metals from one another, and also to more special technical analysis, such as that of commercial copper, zinc, lead, and their ores. All the more recent new methods are included, and the apparatus required is fully described and figured.

(6) The danger of extreme specialisation has been emphasised often enough, but so exaggerated is this now becoming that we are offered from Germany a special course of phytochemical preparations picked out for the would-be botanist. A selection of organic compounds which are in some way connected with plants is made, and the manner of their preparation described in some

detail, so that the student can make them in the laboratory and gain an idea of their individual properties.

There will be no difference of opinion amongst teachers as to the futility of such a plan. The student can get no proper idea of chemistry as a subject, or of its theories and application. He will regard it merely as a series of manipulations, and his text-books as akin to cookery books.

At a time when the teaching of chemistry to medical students is steadily improving it is disconcerting to notice a tendency in the reverse direction in the case of biological students, which unhappily is not confined to the Continent.

MATHEMATICAL BOOKS: ELEMENTARY AND ADVANCED.

(1) *Arithmetic.* By H. Freeman. Pp. viii + 231 + xxxi. (London: G. Bell and Sons, Ltd., 1914.) Price 2*s.* 6*d.*

(2) *The School Algebra.* By A. G. Cracknell. Pp. viii + 568 + lxxvii. (London: University Tutorial Press, Ltd., 1914.) Price 5*s.*

(3) *Statics.* By R. C. Fawdry. Part i. Pp. vii + 165. (London: G. Bell and Sons, Ltd., 1914.) Price 2*s.* 6*d.*

(4) *A First Schol Calculus.* By R. Wyke Bayliss. Pp. xii + 288. (London: E. Arnold, n.d.) Price 4*s.* 6*d.*

(5) *A Treatise on Differential Equations.* By Prof. A. R. Forsyth. Fourth edition. Pp. xviii + 584. (London: Macmillan and Co., Ltd., 1914.) Price 14*s.* net.

(6) *Linear Algebras.* By Prof. L. E. Dickson. Pp. viii + 73. (Cambridge University Press, 1914.) Price 3*s.* net. Cambridge Tracts in Mathematics and Mathematical Physics, No. 16.

(7) *The Elements of Non-Euclidean Geometry.* By Dr. D. M. Y. Sommerville. Pp. xvi + 274. (London: G. Bell and Sons, Ltd., 1914.) Price 5*s.*

(8) *A New Analysis of Plane Geometry, Finite and Differential, with numerous examples.* By A. W. H. Thompson. Pp. xvi + 120. (Cambridge University Press, 1914.) Price 7*s.* net.

(1) THIS book consists mainly of examples, and there is said to be "just sufficient bookwork to be of use to a pupil when in difficulty." We do not think that, for example, any difficulty a pupil may feel about negative numbers can be dispelled by a complete absence of "bookwork" about them (p. 7).

(2) The aim of this book is to bring the teaching of elementary algebra into closer touch with "intelligible" calculations, and also to give a clear account of the elements of algebraic theory. The author warns us that "a rigorous logical account of the fundamental laws of algebra is very difficult, and would be quite out of place in a book of this description." Accordingly, we find, on p. 172, that "*the* negative unit" is defined as "*a* unit which cancels a positive unit" (the italics are ours). In this confusion between definite and indefinite articles, there seems to be some departure from the author's intention to give a clear account of things. The author seems to recognise that such things as the law of signs does present difficulties, but his treatment is not satisfactory. The book is not without merits.

(3) This pleasant little book shows the very healthy influence that the work of Mach has exerted on the teaching of mechanics. It deals with the subject on an experimental basis, and contains many examples, mostly numerical.

(4) This is an attempt to introduce the calculus by means of simple questions based upon matters familiar to the student either from his every-day experience or from his work in the laboratory. It is said to be "planned upon the latest educational theories," but this ought not to prejudice us against a very sound book which contains none of the subtlety that is required in higher walks of mathematics. For example, on p. 153, under the stimulating heading of "The Borderland of Discovery," the introduction of new functions by integration is treated apparently on the principle that any combination of symbols whatever must mean something. This is rather a natural supposition for most budding mathematicians to make, but it would be as well to warn them of possible dangers.

(5) The third edition of this well-known and solid work was published in 1903. This fourth edition is larger, but the general scope of the book is unaltered. Prof. Forsyth's object is to produce a working text-book, and the general theory is scarcely touched upon. Thus, such subjects as theorems of existence are noticed only by a reference to the author's "Theory of Differential Equations." There is an advantage, says the author, "even if only of conciseness," in assuming some results of the theory. Some parts of the book have been re-written, particularly the early part of the chapter on the hypergeometric series, and parts of the chapters on partial differential equations. A number of short additions has been made: on ordinary linear equations with some of their integrals of the type called "regular"; on total differential equations; and on partial equations. The only misprint—if, indeed, it is a misprint—that we have been able to find is a reference in the index to Abel on a page where algebraic functions are spoken of, and not Abel. It is perhaps almost inevitable that a text-book on